

GAM run 04-08

by Shirley Wade

Texas Water Development Board
Groundwater Availability Modeling Section
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REQUESTOR:

Lonnie Stewart, Bee Groundwater Conservation District, Live Oak Underground Water Conservation District, and McMullen Groundwater Conservation District

DESCRIPTION OF REQUEST:

Mr. Stewart requested the following information from the groundwater availability model (GAM) of the central part of the Gulf Coast aquifer system (Chowdhury and others, 2004):

- Water budget in Bee, Live Oak, and McMullen counties.

METHODS:

To address the request, we:

- ran the GAM and queried the budget files for each model layer in Bee, Live Oak, and McMullen counties for the years 2010 and 2020 with long-term average recharge.

PARAMETERS AND ASSUMPTIONS:

We used the following assumptions in this analysis:

- see Chowdhury and others (2004) for assumptions and limitations of the GAM;
- the pumpage is based on the 2006 Regional Water Plan demands. Please see GAM Run 04-19 for a detailed discussion of pumpage; and
- recharge represents average conditions for the predictive period.

RESULTS:

Water budget

Table 1 shows the water budget for Bee, Live Oak, and McMullen counties for 2010 and 2020. Total pumpage for Live Oak County in 2020 is about 1,000 acre-feet less than the sum for Live Oak County in Tables A1 through A4 in GAM Run Report 04-19. The decrease in pumpage is due to a dry cell in the outcrop of Layer 4 (Jasper Aquifer). In the GAM, once a part of the model goes dry, it stays dry, and the pumping is “shut off.” This can result in water levels rising in nearby areas once the pumping in the area is stopped. This also results in less pumping in the model because the pumping has been stopped in these areas. In reality, the aquifer will probably not go dry because pumping will become uneconomical before the aquifer goes dry in any particular area.

The average recharge to the Gulf Coast aquifer system in Bee County is about 23,200 acre-feet per year. The average recharge for Live Oak County is about 5,400 acre-feet per year and the average recharge in McMullen County is approximately 180 acre-feet per year. Table 1 shows the recharge values by aquifer or layer.

Some groundwater conservation districts also include cross-formational flow in their total recharge estimate. Texas Water Development Board (TWDB) rules concerning groundwater management plan certification define recharge as "The addition of water from precipitation or runoff by seepage or infiltration to an aquifer from the land surface, streams, or lakes directly into a formation or indirectly by way of leakage from another formation." We show infiltration from land surface in the recharge column in Table 1. We also show cross-formational leakage into the aquifers in Table 1 in the columns “upper Z flow in and lower Z flow in.”

REFERENCES:

Chowdhury, A. H., Wade, S., Mace, R., E., and Ridgeway, C., 2004, Groundwater availability model of the central Gulf Coast Aquifer System: Numerical simulations through 1999, Texas Water Development Board, Model Summary Report, 113 p.

Table 1. 2010 and 2020 flow budget for Bee, Live Oak, and McMullen counties based on the GAM for the central part of the Gulf Coast aquifer system (values in acre-feet per year for average recharge conditions).

County	Lyr	Change in Storage	X-flow in	X-flow out	upper		lower		Wells	Recharge	ET	Streams	Reserv.	Drains	Total	
					Z flow in	Z flow out	Z flow in	Z flow out							In	Out
2010																
Bee	1	-227	585	-8,673	0	0	711	-3,721	-1,589	18,455	-1,472	-4,070	0	0	24,759	-24,759
	2	-504	2,234	-6,421	3,721	-711	101	-859	-3,159	4,742	-446	1,298	0	0	15,206	-15,211
	3	-211	37	-91	859	-101	171	-618	-93	1	-22	68	0	0	1,259	-1,259
	4	126	434	-798	618	-171	0	0	-162	21	0	-69	0	0	1,338	-1,338
	All	-816	3,290	-15,983	5,198	-983	983	-5,198	-5,003	23,220	-1,940	-2,773	0	0	42,561	-42,566
Live Oak	1	-1	198	-271	0	0	0	-1,360	-41	1,355	-132	252	0	0	1,805	-1,805
	2	-38	2,010	-1,017	1,360	0	211	-161	-792	3,586	-585	-7,059	2,486	-3	10,304	-10,305
	3	223	88	-38	161	-211	542	-463	-400	159	-363	170	134	0	1,962	-1,961
	4	2,935	1,741	-612	463	-542	0	0	-4,025	326	-96	-188	0	0	6,012	-6,011
	All	3,119	4,036	-1,937	1,985	-753	753	-1,985	-5,258	5,425	-1,175	-6,825	2,620	-3	20,084	-20,081
McMullen	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	100	5	-7	0	0	45	-229	-8	13	-250	331	0	0	494	-494
	4	267	164	-687	229	-45	0	0	-8	165	-77	-8	0	0	1,273	-1,273
	All	367	169	-694	229	-45	45	-229	-16	178	-327	324	0	0	1,767	-1,767
2020																
Bee	1	-79	587	-8,720	0	0	753	-3,666	-1,559	18,455	-1,481	-4,292	0	0	24,758	-24,758
	2	-256	2,221	-6,573	3,666	-753	95	-873	-2,881	4,742	-442	1,053	0	0	15,027	-15,028
	3	-159	36	-96	873	-95	151	-690	-93	1	-24	95	0	0	1,215	-1,216
	4	-60	464	-821	690	-151	0	0	-152	21	0	9	0	0	1,404	-1,404
	All	-554	3,308	-16,210	5,229	-999	999	-5,229	-4,684	23,220	-1,947	-3,134	0	0	42,404	-42,405
Live Oak	1	0	210	-266	0	0	0	-1,363	-57	1,355	-132	252	0	0	1,817	-1,817
	2	48	2,133	-1,004	1,363	0	202	-170	-1,199	3,586	-568	-6,882	2,494	-3	10,485	-10,485
	3	420	93	-38	170	-202	401	-745	-496	159	-321	425	134	0	2,143	-2,143
	4	2,962	1,813	-558	745	-401	0	0	-4,936	325	-91	142	0	0	6,477	-6,477
	All	3,431	4,249	-1,866	2,277	-603	603	-2,277	-6,688	5,424	-1,112	-6,064	2,628	-3	20,921	-20,922

County	Lyr	Change in Storage	X-flow in	X-flow out	upper		lower		Wells	Recharge	ET	Streams	Reserv.	Drains	Total	
					Z flow in	Z flow out	Z flow in	Z flow out							In	Out
McMullen	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	57	4	-7	0	0	42	-248	-7	13	-201	347	0	0	464	-464
	4	287	134	-720	248	-42	0	0	-7	165	-77	13	0	0	1,289	-1,289
	All	344	138	-727	248	-42	42	-248	-15	178	-279	360	0	0	1,752	-1,752

Notes:

1. Layer 1: Chicot aquifer
2. Layer 2: Evangeline aquifer
3. Layer 3: Burkeville Confining system
4. Layer 4: Jasper aquifer
5. All: sum of layers
6. **Change in Storage** refers to water that is extracted from storage or added to storage. A positive number means water is extracted from storage. A negative number means water is added to storage. This budget term represents change in storage, not total volume in storage.
7. **X-flow in** refers to lateral flow into the county.
8. **X-flow out** refers to lateral flow out of the county.
9. **upper - Z-flow in** refers to flow into the layer from the layer above.
10. **upper - Z-flow out** refers to flow out of the layer into the layer above.
11. **lower - Z-flow in** refers to flow into the layer from the layer below.
12. **lower - Z-flow out** refers to flow out of the layer into the layer below.
13. **Wells** is for pumping.
14. **ET** refers to groundwater extraction due to evapotranspiration.
15. **Reserv** is reservoir leakage.
16. A negative sign refers to flow out of the layer in the county.
17. A positive sign refers to flow into the layer in the county.
18. The numbers are rounded to the nearest 1 acre-foot. Values in the water budget are probably only accurate to two significant figures.